14

Noise and vibration

14. Noise and vibration

14.1 Introduction

This chapter describes the baseline and potential noise and vibration impacts from the Nolans mine site. A detailed noise and vibration assessment report is provided in Appendix R of this EIS.

The TOR for the preparation of an environmental impact assessment issued by the NT EPA for the Project provided the following environmental objectives in relation to noise and vibration resources:

> *The potential sensitivity of human and biological receptors to noise and vibration and mitigation measures should be discussed in a relevant section of the EIS. The Proponent should address the impact of noise and vibration resulting from the Project on residents and the community in a relevant section of the EIS. The EIS should outline methods for communicating with, and reducing the impact on, residents within the vicinity of Project components or transport corridors who may be adversely affected by the Project.*
>
> *The EIS should outline proposed management to mitigate any identified risks from the Project with regard to noise and vibration emissions. If relevant, the EIS should describe proposed communication with any residents and communities predicted to be impacted by noise and vibration from the Project.*

This chapter addresses the potential noise, airblast and ground borne vibration impacts from the mine site, during the construction and operation of the mine on human and fauna receivers.

14.2 Methodology

A summary of the approach and limitations to the noise and vibration assessment in the study area is summarised below and provided in detail in Appendix R.

Noise criteria applicable for the nearby Project noise sensitive receivers were derived based on the following regulations and guidelines:

- NT EPA Noise guidelines for development sites in the Northern Territory and
- NSW Industrial Noise Policy (NSW EPA 2000).

Aerial photography and a site visit in August 2010 were used to determine the proximity of the closest noise sensitive receivers. The study area for this assessment is defined as including:

- The land within the mine mineral lease boundary
- The Aileron Roadhouse and an access road to the Project site and
- The proposed Nolans Project accommodation village to be located approximately five kilometres south east of the processing plant.

Attended and unattended noise monitoring was conducted in the area surrounding the proposed Project site. The purpose of noise monitoring was to determine the existing noise levels in the area to assist in setting operational noise goals for the Project. Long-

term unattended noise monitoring took place between 10 August 2010 and 18 August 2010. Monitoring occurred at the racecourse in the vicinity of the Aileron Roadhouse.

Acoustic modelling was undertaken to predict the effects of industrial (operational) noise generated by the Project. Applicable construction noise criteria for the Project is 48 dB(A)Leq(15min) and applicable operational noise criteria is 35 dB(A)Leq(15min).

14.3 Existing environment

The community of Aileron Roadhouse and Annas Reservoir are identified to be the nearest human sensitive receivers external to the Project site, and are located approximately 13 kilometres to the south east and 10 kilometres west of the mine site respectively. The Nolans Project accommodation village is approximately five kilometres south east of the processing plant.

Long term background noise levels and ambient noise levels were measured by unattended loggers at two locations at Aileron Roadhouse, the nearest identified receiver. A summary of the results is provided in Table 14-1.

Table 14-1 Summary of unattended noise monitoring results dB(A)

Logger	Background LA90 dB(A)1			Ambient LAeq dB(A)2		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Logger 1 RBL and Leq Overall	28	27	26	43	36	35
Logger 2 RBL and Leq Overall	27	26	25	45	32	34

Notes

1: Background noise: The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.

2: Ambient noise: The all-encompassing noise associated with a given environment. It is the composite of sounds from many sources, both near and far.

Attended noise monitoring occurred over 15-minute periods at each of the long term monitoring locations. Details of the existing noise environment including noise sources and ambient/background noise levels recorded during these monitoring periods are provided in Table 14-2.

Table 14-2 Attended 15 minute period noise monitoring results

Monitoring location and description	LAeq, 15min	LA90,15min	LA10,15min	Comments on noise environment
Logger 1 Racecourse (near Aileron Roadhouse) 10/8/2010 2.47 pm	38	32	41	Typical rural environment with birds and nearby insects influencing the ambient noise. Wind in foliage was audible. Dam water pump noise was faintly audible during monitoring.
Logger 1 Racecourse (near Aileron Roadhouse) 11/8/2010 8.12 am	39	34	42	Typical rural environment with animals and nearby insects influencing the ambient noise. Wind in foliage was audible. Stuart Highway traffic noise was faintly audible and intermittent during monitoring.
Logger 2 Racecourse (near Aileron Roadhouse) 10/08/2010 3.06 pm	43	34	47	Typical rural environment with birds and nearby insects influencing the ambient noise. Wind in foliage was audible. Dam water pump noise was faintly audible during monitoring.
Logger 2 Racecourse (near Aileron Roadhouse) 11/08/2010 8.29 am	41	33	43	Typical rural environment with birds and nearby insects influencing the ambient noise. Stuart Highway traffic noise was faintly audible and intermittent during monitoring.

Notes:

LAeq(15mins) Equivalent sound pressure level: the steady sound level that, over a 15 minute period, would produce the same energy equivalence as the fluctuating sound level actually occurring.

LA10(15mins) The sound pressure level that is exceeded for 10% of the 15 minute measurement period.

LA90(15mins) The sound pressure level that is exceeded for 90% of the 15 minute measurement period.

The background noise levels are low and typical of a rural environment. Measured background noise levels were below the minimum recommended noise level in the *NSW Industrial Noise Policy* (NSW EPA 2000). Therefore, the minimum background noise levels were adjusted up to the recommended 30 dB(A) LA90 before setting the operational noise criteria.

14.4 Assessment of potential impacts

14.4.1 Construction impacts

Construction noise

Typical noise levels produced by construction plant anticipated to be used on site were sourced from *AS 2436 – 2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites* and from GHD's internal database. Applicable construction noise criteria for the Project is 48 dB(A)$L_{eq(15min)}$.

Received noise produced by anticipated activities during the construction phase are shown in Table 14-3 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. The sound pressure levels shown are maximum levels (dB(A) L_w) produced when machinery is operated under full load.

Table 14-3 Predicted construction plant item noise levels (dB(A))

Plant item	dB(A) L_w	Distance of source to receiver (m)							
		50	250	500	750	1000	2000	5000	8000
Crane	105	63	49	43	39	37	31	23	19
Backhoe	104	62	48	42	38	36	30	22	18
Compressor	101	59	45	39	35	33	27	19	15
Concrete pump	108	66	52	46	42	40	34	26	22
Dump truck	117	75	61	55	51	49	43	35	31
Water tanker	107	65	51	45	41	39	33	25	21
Compactor	113	71	57	51	47	45	39	31	27

Noise impact from construction of the proposed Nolans Project is predicted to comply with the adopted criteria at all noise sensitive receivers.

Noise impacts from construction activities will be addressed by the implementation of construction noise mitigation measures in accordance with the noise management plan registered with NT EPA (refer to section 14.5).

Construction vibration

Blasting normally generates the highest levels of ground vibration.

The predicted ground vibrations at various distances are shown in Table 14-4 for typical construction equipment. Given the distance to the nearest receiver from the proposed site is approximately five kilometres, construction vibration is highly unlikely to exceed the human perception criteria.

Table 14-4Predicted construction equipment vibration levels (mm/s PPV)

Plant item [1]	Human perception preferred criteria (maximum criteria)		Predicted ground vibration at given distances				
	Day	Night	10 m	30 m	50 m	100 m	300 m
15 t roller	0.28 (0.56)	0.2 (0.4)	7.5	1.4	0.7	0.2	<0.1
Dozer	0.28 (0.56)	0.2 (0.4)	3.3	0.6	0.3	0.1	<0.1
7 t compactor	0.28 (0.56)	0.2 (0.4)	6.0	1.2	0.5	0.2	<0.1
Rock breaking	0.28 (0.56)	0.2 (0.4)	7	1.3	0.6	0.2	<0.1
Backhoe	0.28 (0.56)	0.2 (0.4)	1	0.2	0.1	<0.1	<0.1

Note 1. NSW RTA Environment noise management manual

Construction blasting

Blasting is likely to be required during construction and operation of the mine. Indicative vibration impact assessment for typical blasting activity have been estimated with consideration to Australian Standard AS 2187.2:2006 *Explosives – Storage and use Part 2: Use of Explosives* (Standards Australia, 2006).

Reductions in levels of ground vibration can be achieved by reducing either the charge mass or increasing the distance to the receptor which reduces the airblast overpressure.

Ground vibration generally attenuates faster than airblast overpressure, and airblast overpressure is generally the critical factor controlling the distance at which blasting can occur without exceeding the human perception preferred criteria. Blasting at distances to receivers of less than 500 m would be restricted by the maximum instantaneous charge.

The maximum construction criteria for airblast overpressure is 115 dB(L) and the ground vibration is 5 mm/s PPV. Airblast overpressure and ground vibration were predicted for a range of charge masses. As shown in Figure 14-1 and Figure 14-2, the airblast overpressure and ground vibration levels for the assessed charge masses are expected to be well under the criteria at the nearest sensitive receiver located approximately five kilometres from the source.

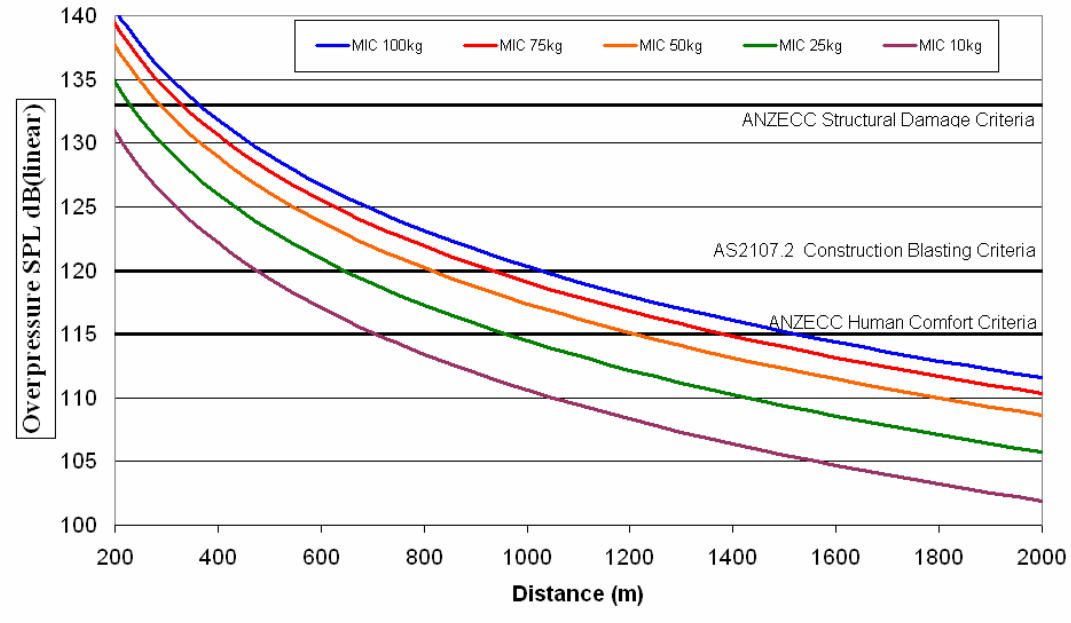


Figure 14-1 Airblast overpressure predictions for different charge masses and distances

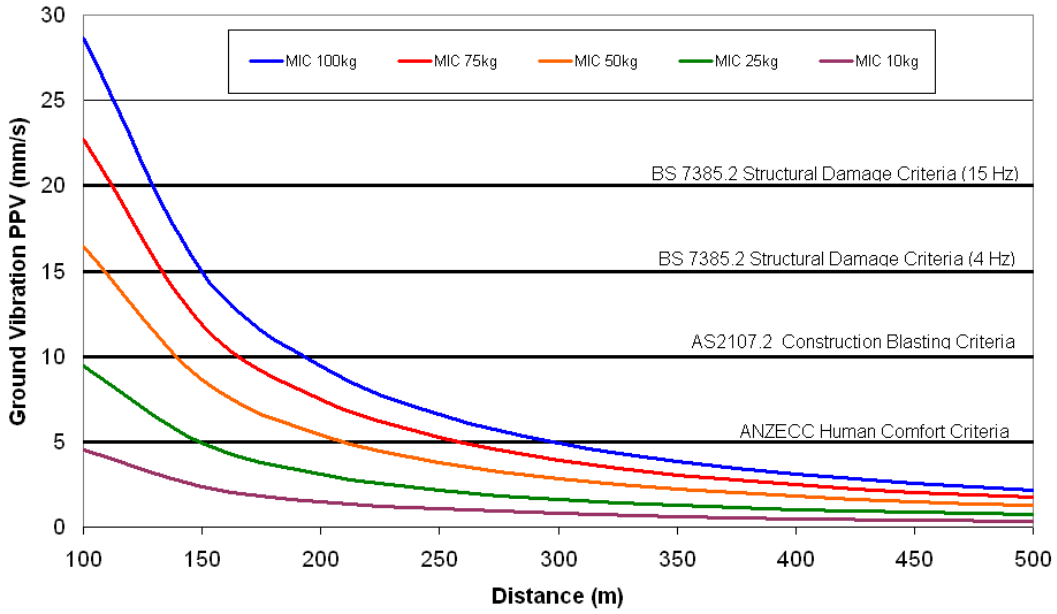


Figure 14-2 Ground vibration predictions for different charge masses and distances

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods. This should not affect blasting during the recommended standard hours stipulated in ANZECC.

No details of the blast configuration and design have been supplied at this stage. A maximum instantaneous charge of greater than 100 kg should not be required and a

charge of 50 kg or less is likely to be appropriate. As the nearest receiver is greater than five kilometres away, ground vibration from blasting is not predicted to be an issue.

If blasting activity occurs, the design of blast will be determined by the blast contractor and therefore the above information has been assumed for this assessment only in the absence of specific information regarding blasting at the proposed site.

14.4.2 Operational impacts

Operational noise

Due to staging, noise impact will vary over the proposed life of the mine, depending on where machinery is operating. Areas where these changes will occur are the mine pit and the waste rock dump.

Modelled sound power levels for mobile and fixed sources (modelled as point sources) for the proposed mine and processing sites are summarised in Table 14-5. The plant and equipment listed in the table are expected to be the major noise sources from the Project, and that the associated sound power levels (dB(A) L_w) per unit are maximum predicted levels produced when machinery is operating under full load.

Table 14-5 Modelled operational noise sources

Plant item [1]	Make and model	dB(A) Lw per unit	Peak quantity	Modelled source height (m)
Excavator	Hitachi EXI 200	123	3	3
Dump truck	CAT 777F	117	11	4
Dozer	CAT D9T	111	3	3
Grader	CAT 16M	109	2	4
Service truck	MAN 6x6	107	1	3
Water truck	MAN 6x6	107	2	3
Rock breaker	CAT 336DL	118	1	1
Lighting plant	Alight	90	12	1
Front end loader	CAT 990H	112	2	4
Surface crawler drill	Sandvik DP1100	119	6	2
RC drill	Atlas Copco RC127	119	1	2
Dewatering pump	Chesterton	98	3	1
Acid plant compressor	n/a	122	1	5 (ground based plant source) 20 (stack source)

Plant item [1]	Make and model	dB(A) Lw per unit	Peak quantity	Modelled source height (m)
Milling	n/a	118		4
Screener	n/a	111	1	2
Primary crusher	n/a	116	1	3
Secondary crusher	n/a	112	1	3
5 MW gas turbines	n/a	127 (engine noise) 136 (exhaust stack)	3	5 (ground based plant source) 12.5 (stack source)

Note 1. Typical mining equipment noise levels in Table 14-5 have been obtained from:

- Australian Standard AS 2436 – 2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- Engineering Noise Control software
- GHD's internal database from past project experience.

The predicted sound pressure levels due to the operation of the Project at nearby noise sensitive receivers are summarised in Table 14-6. Operational noise model contours are also shown graphically in Figure 14-3.

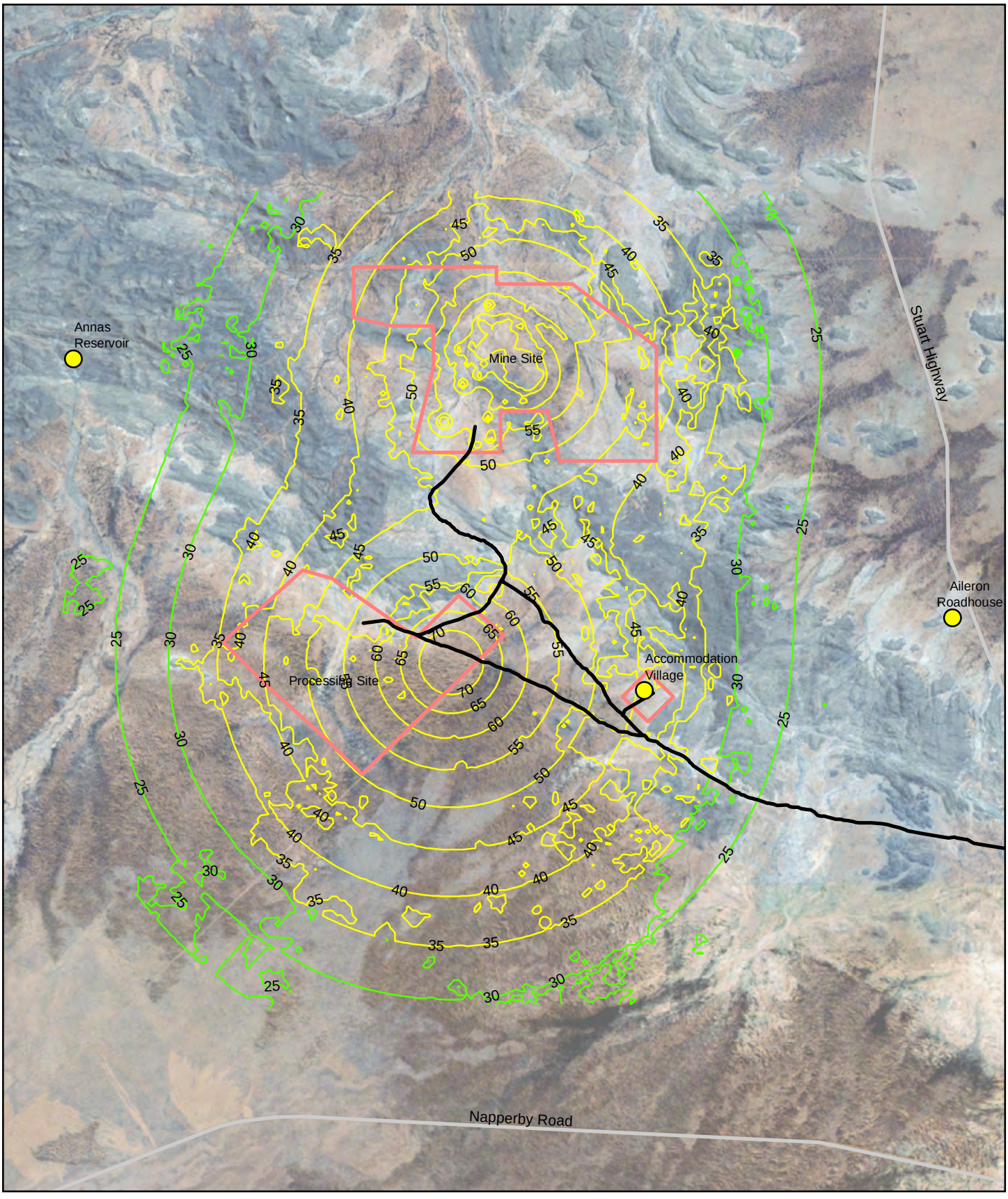
Applicable operational noise criteria for the Project is 35 dB(A)$L_{eq(15min)}$). Table 14-6 shows that the Project's operational noise impact at the Aileron Roadhouse and Annas Reservoir receivers are expected to be below the noise criterion. However, potential 10 dB(A) exceedance is predicted to occur at the Nolans accommodation village receiver, based on the modelling assumptions.

Analysis of predicted dominant noise sources at the Nolans accommodation village receiver, has indicated that the gas turbines stacks at the power station site are the primary contributors. Design of the turbines will include installation of a noise attenuator (silencer or equivalent) at the gas turbine exhaust stacks. The installed attenuator should achieve an overall noise reduction level of 20 dB(A) or more to the stack noise levels. Predicted operational sound pressure levels with the noise attenuator are summarised in Table 14-6 and shown on Figure 14-3.

Table 14-6 Predicted operational sound pressure levels dB(A) at modelled receivers

Nearest sensitive receiver locations [1]	Project noise criteria dB(A) $L_{Aeq(15min)}$	Predicted noise levels dB(A) $L_{Aeq(15min)}$	Comply	Predicted noise levels dB(A) $L_{Aeq(15min)}$ with noise attenuator	Comply with mitigation
Accommodation village	35	45	No	34	Yes
Aileron Roadhouse	35	12	Yes	8	Yes
Annas Reservoir	35	< 5	Yes	13	Yes

Note 1. Prediced for all periods



LEGEND

Receivers
Roads
Access Road

Noise Contours

< 35 dB(A)LAeq
>= 35 dB(A)LAeq

Project Areas

1:125,000 @ A4
0 1 2 3 4
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

Arafura Resources Limited
Nolans Project
Environmental Impact Statement

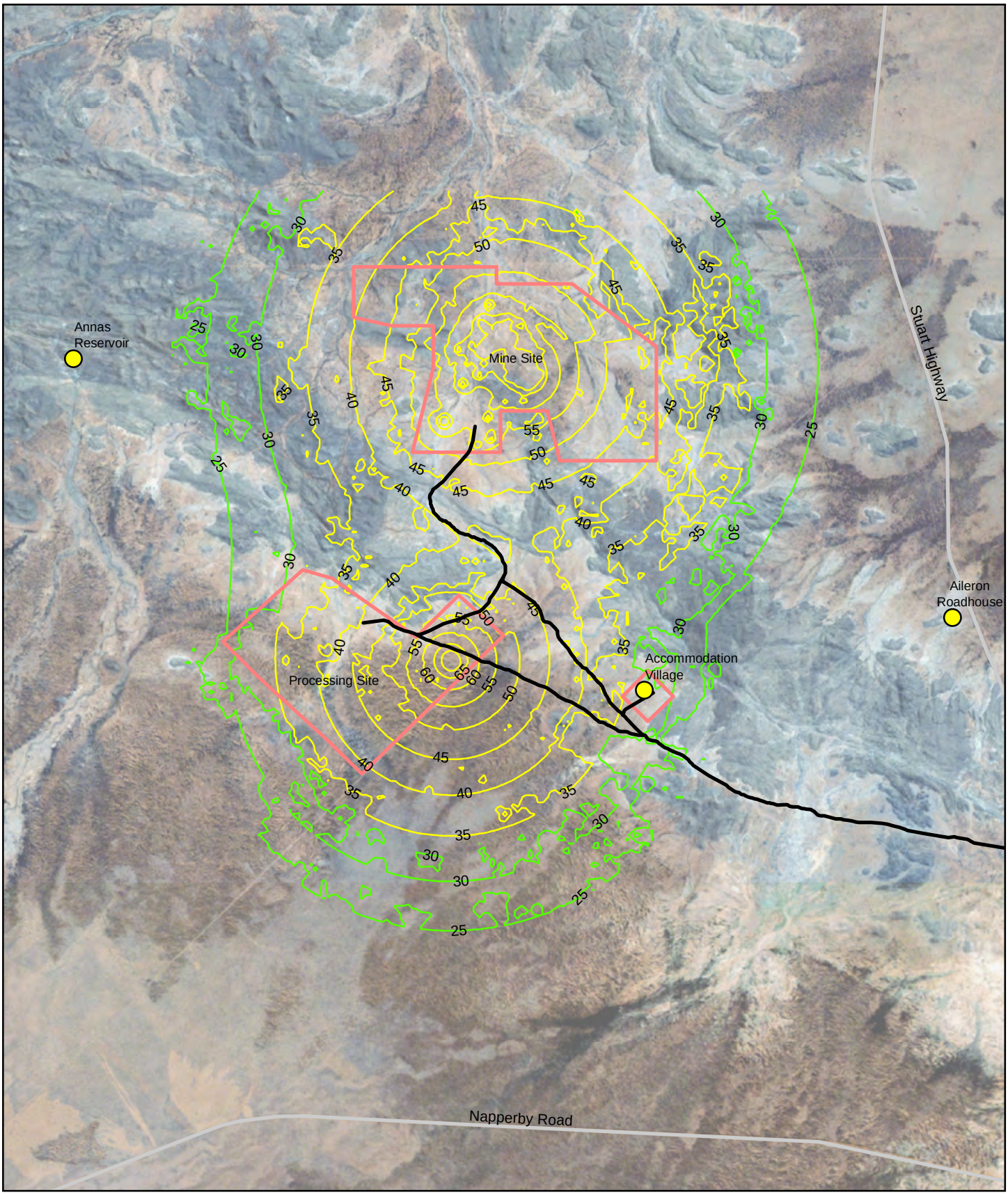
Predicted operational noise impact contours

Job Number	43-22301
Revision	0
Date	13 Apr 2016

Figure 14-3

G:\43\22301\GIS\Maps\4322301_034_PredictedOperationalNoiseImpactContour.mxd
Level 5, 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: GA - Roads, Waterways, Placenames, Placenames, Lakes (2015). ESRI - Shaded Relief (2009). Google Earth Pro - Imagery (Date extracted: 05/11/2015). ARL - Project Areas (2015). Created by: CM



LEGEND

Receivers
Roads
Access Road

Noise Contours

>=35 dB(A)LAeq
< 35 dB(A)LAeq

Project Areas

1:125,000 @ A4

0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

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Job Number 43-22301
Revision 0
Date 13 Apr 2016

Predicted operational noise impact contours with noise mitigation measures

Figure 14-4

G:\43\22301\GIS\Maps\4322301_035_PredictedOperationalNoiseImpactContourMitig.mxd

Level 5, 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: GA - Roads, Waterways, Placenames, Placenames, Lakes (2015). ESRI - Shaded Relief (2009). Google Earth Pro - Imagery (Date extracted: 05/11/2015). ARL - Project Areas (2015). Created by: CM

Traffic noise

Road access for construction, service, delivery and workforce traffic will be via an upgraded station road in the area, which ultimately connects to Stuart Highway.

The distance between the sealed access road past the Nolans Project accommodation village is approximately 1.5 kilometres. The Aileron Roadhouse is located about 11 kilometres east from the village. Based on typical truck sound power level of 107 dB(A), which equates to a sound pressure level of 35 dB(A) at 1.5 kilometres and 19 dB(A) at 9.5 kilometres. Based on these calculations, as well as the intermittent nature of truck movements, traffic noise along the access road due to the Project is not expected to cause significant impact at the assessed receivers.

Stuart Highway is a government controlled road potentially affected by the Project. The Aileron Roadhouse receiver is located approximately 11 kilometres to the north of the intersection between Nolans site access road and Stuart Highway. Due to this significant distance, Project traffic noise impact along Stuart Highway is not expected to cause significant impact at the Aileron Roadhouse receiver.

Due to substantial distance separation between the unsealed access road and the sensitive receivers, as well as the transport route along Stuart Highway to Alice Springs, traffic noise from the Project is not expected to cause significant impact at the assessed receivers.

Operational blasting

Refer to construction blasting in section 14.4.1.

Construction and operational vibration

All rotating equipment within the Project site will be vibration isolated using vibration isolation mounts, as per manufacturer's recommendations.

Due to the extensive distance (five kilometres or more) from source-to-receiver, it is expected that equipment vibration associated with the operation of the Project would be insignificant at identified nearby sensitive receivers.

Noise impacts on livestock

Sudden noise has the potential to startle or upset domestic livestock and pets. Studies (Heggies 2009) have considered the effect on farm animals to sonic booms (sonic booms being similar in character to airblast from blasting). These studies have indicated that reactions of sheep, horses and cattle to sonic booms (125 dB to 136 dB) were considered slight to mild. Results showed that less than 20 percent of the sonic booms studied caused even a mild reaction on sheep, horses and dairy cattle in temporary cessation of eating, rising of heads and slight startle effects. The total individual milk yield was observed and no affect was found on the overall milk production.

Given these conclusions, it is considered unlikely that the Project will have an adverse effect on livestock in the vicinity of the Project.

Noise impacts on native fauna

Disturbance to fauna associated with generation of unexpected and/or excessive noise and vibration from mining and processing activities during construction can result in the displacement of fauna and disruption to nesting/roosting/foraging behaviour. With mitigation measures in place the risk of impact associated with noise and vibration has been assessed as being low.

Potential noise impacts on fauna is discussed in Chapter 9.

14.5 Mitigation and monitoring

14.5.1 Construction noise

A noise management plan will be prepared and implemented and will include, as a minimum:

- Justification for work on the development site, that is likely to be undertaken outside of the acceptable construction times (between the hours of 7 am and 7 pm Monday to Saturday and/or between the hours of 9 am to 6 pm on a Sunday or public holidays. Whilst acknowledging Arafura's proposed construction hours between 6 am to 6 pm, and the rural location of the project, justification of work outside this period may be required.
- Details and the duration of the activities on the development site likely to cause noise emissions that may exceed the construction noise levels defined in noise guidelines for development sites in the Northern Territory (NT EPA 2013) during a period specified in Clause 10.1
- Details clearly demonstrating how site activity will comply with 'AS 2436 *Guide to Noise and Vibration Control on Construction, Maintenance and Demolition Sites*'
- A complaint management system and documented complaint response procedure
- Documentation on the verifiable consultation and feedback program with occupants of all affected premises, demonstrating that all occupants were provided with advice on dates, times and nature of any potentially noisy and disruptive activity including measures proposed to mitigate such activity as well as noise complaint contact details
- Name of the onsite person who will be responsible for implementing the noise mitigation plan and the name and phone number of the person to whom a complaint may be made about noise emissions from the site

In addition, the following general construction noise mitigation measures will be implemented

- Where possible, activities that could result in elevated noise levels will be scheduled during NT EPA prescribed acceptable construction times (0700 to 1900 hours Monday to Saturday). However, justification of work outside the NT EPA acceptable construction times may be needed (as required in NT EPA guidelines) should this be not possible.
- Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. In any case, all equipment used on site should be in good condition and good working order.
- Plan to use equipment that is fit for the required tasks in terms of power requirements.
- All engine covers should be kept closed while equipment is operating.
- As far as possible, material drop heights into or out of trucks should be minimised.
- Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements.
- All combustion engine plant, such as generators, compressors and welders should be checked to ensure they produce minimal noise.
- Vehicles should be properly serviced. The use of exhaust brakes should be eliminated, where practicable.
- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods.

- Machines found to produce excessive noise compared to industry normal standard should be removed from the site or stood down until repairs or modifications can be made.

14.5.2 Operational noise

All mobile equipment will be selected to minimise noise emissions and maintained in good repair. Machines found to produce excessive noise compared to normal industry expectations will be removed from the site or stood down until repairs or modifications can be made. Where required, noise attenuation will be installed in gas turbines exhaust stacks.

Broadband reversing alarms (audible movement alarms) will be used for all site equipment, subject to meeting occupational health and safety requirements.

All site workers will be informed of the potential for noise impacts and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. These measures will include:

- Where practical, machines will be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods
- Minimising reversing with beepers
- Avoid metal to metal contact on material
- All engine covers will be kept closed while equipment is operating.

Equipment design specifications will include noise limits and associated acoustic attenuation requirements.

Equipment and task specific procedures/work instructions will include noise management, hearing protection training and personal protective equipment instructions.

14.5.3 Vibration

The following construction and operational vibration mitigation measures will be considered to reduce the impact on the surrounding receivers:

- Use of smaller capacity vibratory rollers
- Use of static rollers opposed to vibratory roller/compactors where possible
- Vibration intensive activities to be undertaken during the least sensitive time periods
- Operations sequenced so that vibration intensive activities do not occur simultaneously, where possible.

14.5.4 Blasting mitigation measures

Any blast on site will be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this report.